

# Example of m m 1 queue system report

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## INTRODUCTION

M/M/1 Queue refers to a stochastic approach whose state range is the situation  $\{0, 1, 2, \dots\}$  whereby the value represents the number of clients in the entire system together with those who are presently in the service. M/M/1 queuing system is currently the most widely used analytical tool for large and complex models where the traditional optimization approaches such as mathematical programming and optimal control methods are no longer efficient.

This report gives an overview of how to use the node together with the project editor to create an M/M/1 queue, gather statistical data regarding the model, execute the simulation, and carry out result analysis.

## OBJECTIVE

The objective of this laboratory experiment is to create a better insight on OPNET system and its associated user interface and to allow the learners to build, observe, experiment, and measure different types of networks as well as to balance the dimensions of knowledge in an introduction to networking. Another objective of this queuing system is for the learners to understand the use of project editor in gathering and visualizing various types of statistics available. In addition, the learner learns how to apply filters to data obtained from the simulated model. Finally the learner learns how to carry out mathematical analysis of statistic data. This report seeks to explain the relationship between the mean rate of packet arrival, the queue size, and the capacity of service. If joined effect the mean rate of packet arrival and the mean packet size surpasses the capacity of service, then the size of queue

grows uncontrollably. This M/M/1 queue report is meant to stabilize the above mentioned parameters.

## RESULTS

Results collected include the average time of packed delay within the infinite buffer and the average number of packets waiting in the queue. These two statistical results are sufficient to answer two fundamental questions in such network. These are:

Does the average time that a packet waits in the queue surpass an acceptable limit?

Does the size of queue grows monotonically, or does it settle down at the same point?

Taking  $\rho$  as the intensity of traffic, intensity of traffic is defined as the arrival rate ( $\lambda$ ) divided by the average service rate ( $\mu$ ),

$$\rho = \lambda / \mu$$

$$N = \rho / (1 - \rho)$$

$$T = 1 / (\mu - \lambda)$$

Here we see that wait time becomes large as the mean rate of arrival ( $\lambda$ ) tends to the mean service rate ( $\mu$ ).

So having mean arrival rate  $\lambda = 1 / (\text{mean interarrival time}) = 1 \text{ p/s} = 1 (\text{p/s})$ , and

Mean service requirement  $1/\mu = 9000 (\text{b/p})$ , and

Service capacity  $C = 9600 (\text{b/p})$ ,

Mean service rate  $\mu C = (1 / (9600 (\text{b/p}))) (9600 (\text{b/s})) = 1.067 (\text{p/s})$

Mean delay  $\tilde{\omega} = 1 / (\mu C - \lambda) = 1p / (1.076(p/s) - 1(p/s)) = 1p / 0.067(p/s) = 15s$

The timed-average size of queue is displayed in the graph of time against. To get this a time average filter was applied to the queue size.

## DISCUSSION

M/M/1 queue is negative exponential arrivals and service times with one server. M/M1 queuing system presupposes Poisson arrival procedure. This assumption is perfect for arrival procedures in real world systems that satisfy the following criteria:

1. The number of clients in the entire system
2. Effect of one client on the entire system is significantly small
3. All clients are independent on system usage

Having established situations whereby an assumption can be taken on the arrival procedure to be Poisson, probability density for a Poisson process can be determined. The equation below describes the likelihood of n arrivals in a period 0 to t

$$P_n(t) = ((\lambda t)^n / (n!)) \cdot e^{-\lambda t}$$

Where t is time interval 0 to t, n is number of arrivals in time interval 0 to t, and  $\lambda$  is total average rate of arrival in arrivals per second.

In this model it was also assumed that customers' service time are negative exponent kind of distribution. With M/M/1 queue, a single server is available for the entire queue. As the packet arrives at the head of an infinite buffer, it undergoes processing by the server and later sent to its desired destination.

In creation of this M/M/1 queue, objects such as Node Editor together with a single queue and two processors are required. The two processors are the source module and the sink module. Packets are generated by the source module while the sink module disposes off the generated packets.

Source component generates and specifies the speed of creation of generated packets in packets per second. This rate is depicted by an exponential distribution of intervals of packets arrival. Queue component represents the infinite buffer as well as the server. Packet streams were used to transmit packets between the generating component, the queue component, and the sink component. Node editor was used to build node models comprising of modules linked together by packet streams and statistic wires.

Attributes such as processor's speed of packet generation, generation distribution, average size of packets, and the distribution size were set in the processor component. The part responsible for generating packets in M/M/1 model is complete. Packets were generated in accordance with the exponential PDF values that were assigned.

Having all the components required to emulate the queue placed in workspace and well configured, packet streams were applied to allow packets movement from one module to another.

Network model was the created on the project editor whereby a subnet was defined and the nodes were placed within the limits of the subnet. New model list was first created by modifying it to display only the desired network objects. Followed the palette configuration was the creation of network model. Finally statistics to be collected in the simulation were set.

## CONCLUSION

Simulation results validation is important. This is done through comparison with theoretical results. From the graphs of mean queuing delay and time-averaged size of queue, there is a commonality. This is because of large number of equally dispersed queue insertions and removals occurring during the simulation process. The difference existing between the end values of both statistics tends to null.

Graph of queue size against time-averaged queue size concludes that time average is within the acceptable limits of 20 seconds and the queue stabilizes at about 4 hours, no monotonic growth.

## References

- Guo, J., Xiang, W., & Wang, S. (2007). Reinforce Networking Theory with OPNET Simulation. *Journal of Information Technology Education* , 216-224.
- Robertazzi, T. G. (2007). *Networks and grids: technology and theory*. New York: Springer.